Using an Atomic Molecular Optics Laboratory for Undergraduate Research and Mentoring of Physics Students in Georgia

An Atomic and Molecular Optical (AMO) Physics research lab is an excellent tool to train and mentor undergraduate students in advanced laboratory techniques. Students gain valuable basic experience in experimental designs, data acquisition techniques, working with high precision optical equipment, building electronics, and working in the machine shop.

The current project is building and testing an enclosure for the diode laser to reduce sound and vibrational interference. In addition, we are developing and evaluating a new, more compact laser cavity which is 3d printed. Previously completed projects involved building a temperature controller, current supply circuit, machining the laser mount, milling the vacuum chamber mounts to support the chamber, and machining the Helmholtz coils for the chamber, which are being used to trap the atoms in a Magneto Optical Trap (MOT). This included designing, building, and baking out the vacuum chamber, constructing a trap for the Rb in the chamber, and building the lasers for a saturation-absorption system that is used to probe the $5^2S_{1/2} \rightarrow 5^2P_{3/2}$ hyperfine energy transitions of the Rb-85 atom. These energy transitions have been used to frequency-lock a diode laser to trap Rb-85 atoms and then cool them to ultra-low temperatures. The atom cooling will permit observation and measurement of the fundamental properties of atoms. This lab has mentored and supported over twelve undergraduate students in the last four years, of which one became a High School Teacher, three joined Ph.D. programs, one continued in a master's level engineering program, and one went to graduate school to study bioengineering.